

REMARKS

Claims 1, 2, 5-7, 9, 12, and 15-18 are pending in this application. Claim 3-4, 8, 10-11 and 13-14 have been canceled.

Example 2b on page 17 of the present specification has been amended to correct a typographical error and indicate that it refers to Example 1b, rather than Example 1a, as does Example 2a. This is apparent, since Example 2b refers to Fig. 4b, which illustrates the use of PAH and CdS. Fig. 4 b illustrates a comparison between the spin SA method of the present invention (Example 2b) and the conventional dipping SA method (Comparative Example 1b) for PAH/CdS films, as stated on page 8 of the present specification in reference to Fig. 4b.

Claim 15 has been rejected under 35 U.S.C. § 112, first paragraph as failing to comply with the written description requirement (Section 5 of the Office Action). Claim 15 is now amended to recite that the washing steps are performed twice between coating steps, as suggested by the Examiner, and disclosed, for example, in Example 1b on pages 16-17 of Applicants' specification. Accordingly, the rejection of claim 15 may be withdrawn.

Claims 1, 2, 5-7, 9, 12-14 and 16 are rejected under 35 U.S.C. § 102(a) as being anticipated by the newly-cited article of Cho et al. (Section 7 of the Office Action).

Submitted herewith is a Declaration Under 37 C.F.R. § 1.132 in which the inventors Jong-Dal Hong, Kook-Heon Char and Jin-Han Cho indicated that they are the inventors of the subject matter disclosed in the Cho et al article (Paragraph No. 2). Further, Professor Ki-Bong Lee, while listed as a co-author of the article, worked under the direction and supervision of Dr. Char to investigate the internal structure analysis of multilayer ultrathin films (Paragraph No. 3). The declaration further specifies that Professor Lee did not contribute to the process described in the Cho et al article or described and claimed in the present application. Accordingly, the Hong et al declaration removes the Cho et al article as a reference under 35 U.S.C. § 102(a). *In re Katz*, 687 F.2d 450, 215 USPQ 14 (CCPA 1982); MPEP §§ 715.01(c) and 716.10.

Accordingly, the rejection of claims 1, 2, 5-7, 9, 12-14 and 16 under 35 U.S.C. § 102(a) as being anticipated by the newly-cited article of Cho et al should be withdrawn.

Claims 1, 2, 5-7, 9 and 12-16 are rejected over U.S. Patent No. 5,208,111 to Decher et al (“Decher et al”) in view of U.S. Patent No. 6,589,665 to Chabreck et al (“Chabreck et al”), alone, or over Decher et al in view of Chabreck et al and U.S. Patent No. 5,393,624 to Ushijima (“Ushijima”) in Section 10 of the Office Action.

In the paragraph bridging pages 2-3 of Section 3 of the Office Action, the Examiner acknowledges that unexpected results are shown in the Examples and Figures 4a and 4b to overcome the rejections of Decher et al in view of Chabreck et al. However, the Examiner takes the position that the claims are not commensurate in scope with the showing of unexpected results. In view of the following remarks, it is not believed that a discussion of Decher et al in view of Chabreck et al is necessary.

In order to advance prosecution, claim 1 has been amended to recite that the spin speeds are 2000-6000 rpm, which corresponds to canceled claim 8. The Examiner indicates that the Examples are all performed using polyelectrolyte materials. However, as shown in the following tabulation of the Examples and the Applicants’ specification at page 10, lines 13-17 and page 11, line 8 to page 12, line 5, materials other than polyelectrolytes were used for fabricating the film of the present invention.

TABLE

Examples	Interaction between materials	Materials	Results	
1a, 2a, 3a, 4, 5, 6 and 7	electrostatic interaction	PAH/PSS		polyelectrolyte
1b, 2b, 3b and 8	electrostatic interaction	PAH/negatively charged CdS	Fig. 3b, Fig. 4b, Fig. 5b and Fig 10, respectively	polyelectrolyte, inorganic nanoparticle

9	electrostatic interaction	(PAH/PSS)/(PAH/CdS)	Fig. 11	polyelectrolyte, inorganic nanoparticle
10	electrostatic interaction	(positively charged CdS /PSS)/(PAH/PSS)	Fig. 12	polyelectrolyte, inorganic nanoparticle
11a	hydrogen bonding	polyaniline/poly(vinyl pyrrolidone)	Fig. 14	polymer
11b	hydrogen bonding	poly(vinylpyridine) /CdSe	Fig. 15	polymer, inorganic nanoparticle

For example, the CdS used in the multilayer films for comparative data is not a polyelectrolyte. As shown in Fig. 3b and Fig. 4b, the adsorbed amounts of the PAH/CdS formed by Example 1b were larger than those formed by Comparative Example 1b, although the PAH concentration used in Example 1b was lower than that used in Comparative Example 1b.

Similarly, Fig. 10 includes comparative data of two PAH/CdS multilayer films, which are prepared by the spin SA method of Example 2b and the conventional dipping SA method of Comparative Example 1b, respectively, although CdS is not a polyelectrolyte. Likewise, the polyaniline, poly(vinylpyrrolidone) and poly(vinylpyridine) used in Examples 11a and 11b are not polyelectrolytes, and are merely polymers. Accordingly, it would be unduly restrictive to limit claim 1 to polyelectrolytes. Also, since the particular spinning time is determined in consideration of the time for removing the particular solvent used in the coating and washing step, and thus is influenced by the choice of solvent, spinning speed and the like, and is determined on a case-by-case basis. Thus, it would be unduly restrictive to limit the spinning times beyond the range presently claimed.

Claim 8 has been canceled by the present Amendment in view of the amendment to claim 1. In addition, claims 13 and 14 were canceled since they were dependent upon claim 8, and replaced by corresponding claims 17 and 18 dependent from different claims.

Accordingly, it is believed that the rejection of claims 1, 2, 5-7, 9 and 12-16 over Decher et al

in view of Chabreck et al, alone, or Decher et al in view of Chabreck et al and Ushijima may now be withdrawn in view of the amendment of claim 1 and the foregoing comments.

Claims 1-2, 5-7, 9 and 12-16 are additionally rejected under 35 U.S.C. § 103(a) as being unpatentable over the Dubas et al article on pages 8153-8160 of *Macromolecules* entitled "Factors Controlling the Growth of Polyelectrolyte Multilayers."

Unlike Applicants' claimed multilayer film forming process in which a bindable material and washing solvent are alternatively dropped onto a spinning substrate, the Dubas et al method is a hydrodynamic method in which the substrate on a rotating shaft is dipped into beakers of the layer producing material and solvent. Thus, the Dubas et al process is a dip cycling method employing a robotic platform (see description in paragraph bridging pp. 8153-8154) in which the silicon substrates are affixed to a stainless steel shaft, the shaft is dipped into beakers placed on the platform and rotated in the beaker. In this regard, the Examiner is referred to the Schlenoff et al article of record in *Langmuir* 2000, pp. 9968-9969, in which Dubas and Schlenoff are co-authors, and which refers to the Dubas et al method in the *Macromolecules* article as "Dip cycling employed a robotic platform..." (p. 9968, column 2, lines 9-10).

In the hydrodynamic method, layers on a silicon wafer are produced by rotating the silicon wafer while immersing it alternatively in two oppositely charged polymer solutions with rinses of fresh water in between, using a rotating platform for the beakers as shown in Fig. 12 and 13 of the Dubas and Schlenoff U.S. Patent No. 6,460,424 B1. Since producing and washing layers on a wafer are performed by immersing the wafer into a solution or solvent, rather than dropping such material onto a spinning substrate as in Applicants' process, the dip cycling method of Dubas et al requires a further step for removing the solvent after each step or at the end.

Dubas et al dry the wafer after each layer producing step and washing step in the first experiment, but the wafer was not dried for subsequent experiments, as explained in the

discussion beneath Figure 1 on page 8154. Moreover, Dubas et al state (page 8154, column 1, last 5 lines), that layer thickness for the PSS/PADMA combination does not depend on whether the multilayer has been dried between layer pairs. Thus, unlike the process of the present invention, Dubas et al indicate that solvent removal in each step is not necessary for producing well defined multilayers.

In the present invention, facile solvent removal at each step is indispensable for producing well defined multilayers and a further step for removing the solvent is not necessary, since forming layers and removing solvent are simultaneously achieved by high spinning speed in a short time. In the Dubas et al dip cycling method, the driving force for forming layers is generated only by electrostatic attraction like the Decher et al method. Thus, Dubas et al state (page 8154, column 1, lines 36-38) that the trends in film thickness on these rotating substrates are similar to those for static dip-cycled multilayers.

In the present invention, however, the multilayers are formed not only by the attractive intermolecular force between adjacent layers, but also by the viscous force due to facile solvent removal during spinning. In addition, a centrifugal force and an air shear force are other driving forces for producing the multilayers of the present invention because the multilayers are built up against gravitational direction. The fast adsorption of materials and elimination of weakly adsorbed materials during spinning can be simultaneously carried out because of the centrifugal force. The weakly adsorbed material may significantly increase the surface roughness of the multilayer film, yielding poor film quality.

Accordingly, for the reasons indicated, Applicants' process as recited in claims 1-2, 5-7, 9 and 12-16 is distinguishable and unobvious over the dip cycling method of the Dubas et al article, and the rejection over such claims should be withdrawn.

For the foregoing reasons it is submitted that the claims are in condition for allowance. Such action is earnestly solicited.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "David S. Abrams", written over a horizontal line.

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Dated: 11/15/04